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Lathyrus sativus: An orphan or wonder crop

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Abstract

Grass pea (*Lathyrus sativus*) is a Neolithic robust legume plant which is a very resilient towards climate change and has survived millennia of cultivation. This characteristic makes it a wonder crop and survival food during drought-triggered famines. The root system of the crop is also deeply penetrating making it convenient to survive in many soil types and it is also very competent nitrogen fixer which not only benefits itself by meeting the nitrogen requirements but also provides with beneficial crops to the subsequent crop. Though *Lathyrus* possess excellent agronomic properties and can be used for consumption, overeating has led to a severe crippling neurological condition known as neurolathyrism. Studies have observed that if grass pea is incorporated as a part of balanced diet and the methionine deficiency is checked for the deleterious effects of neurolathyrism is almost non-existent. In the present scenario of global climatic changes and the food scarcity for humans and also animals this adaptable crop needs much more consideration. Moreover, *Lathyrus* is the only known source of L-Homoarginine which is an Arginine analogue and possess excellent nutraceutical properties. Hence an overview on the *Lathyrus* which can be a promising crop and can be a great alternative non-conventional feed resource in animal nutrition.

Keywords: *Lathyrus*, L-Homoarginine, Nutraceutical, Neurolathyrism

Introduction

Lathyrus provides ample opportunities to diversify the existing cereal based cropping systems to manage the risk of unpredictable weather and increases the profitability and sustainability of agriculture under the climate change scenario. Apart from having positive impact on soil nitrogen requirement it requires minimum agronomic inputs and gives reasonably good yield under the most adverse agro-climatic conditions making it an integral component of the subsistence agriculture in tropical countries (Muehlbauer and Tullu 1997) [1]. Further, it does not get affected by the water logging conditions and the associated anaerobic conditions (Campbell *et al.* 1994) [2] owing to this ability it is usually broadcasted as Relay crop in rice harvesting.

Grass pea (*Lathyrus sativus* L.) also known as Khesari or Batura and Dhal (Muehlbauer and Tullu, 1997) [1] in India is an annual pulse crop belonging to the tribe Viciaeae, family Fabaceae (Biswas and Biswas, 1997) [3] (fig1). Only four out of the 150 species (Allkin *et al.*, 1983) in the genus *Lathyrus* are to be found in India viz., *L. sativus*, *Lathyrus odoratus*, *Lathyrus ochrus* and *Lathyrus aphaca* (Tarade *et al.*, 2007) [4]. *Lathyrus* in Greek (“la thyros”) means very (*la*) passionate (*thyros*) referring to its aphrodisiacal qualities of it (Loudon *et al.*, 1855) [5]. According to Lambein *et al.*, (2019) [6] *Lathyrus* was presented to kings as a special food. *Lathyrus* is a classic orphan crop (Cullis and Kunert, 2017) [7] has well adapted itself to a varied agro climatic conditions ranging from highland volcanic soils of Ethiopia (Fikre *et al.*, 2011b) [8] to drought-prone areas of North America including Eurasia, temperate South America, and East Africa (Dixit *et al.*, 2016) [9], heavy clay in the paddy rice (*Oryza sativa*) fields of Kashmir and Nepal Bangladesh (Girma and Korbu, 2012) [10] which is not a common finding in orphan crops as their distribution is restricted to a particular geographical area depending on their capability to adapt to that particular agro climatic conditions. This could be attributed to its incomparable agronomic properties as a result of its hardy and penetrating root system which makes it drought tolerant, surviving in floods and high saline conditions and the capacity of nitrogen fixation (Lambein *et al.*, 2019) [6]. As a result of its nitrogen fixation and moisture retainment abilities it is the only alternative crop after the rice cultivation (Yadav and

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Mehta, 1995) [11].

All the above listed qualities make it a perfect orphan legume crop but still it did not get its due credit due to the presence of toxic components, but the scenario is changing especially after L-Homoarginine has been characterised from grass pea making it as a potential “functional food” (Llorent-Martínez *et al.*, 2017) [12] and also it shares the similarities in terms of amino acids profile with many other legumes grain legumes (Hanbury *et al.*, 2000) [13].

Albeit all the characters of lathyrus stated above and it being the natural source of L-Homoarginine which is the methylated form of L-Arg and also the substrate of NO the bio signalling molecule with diverse roles to play it was not credited with its due until recently due to the stigma associated with the neurotoxicity in humans and animals (Lambein and Kuo, 2009) [14], occurrence after the consumption of sole lathyrus due to the presence of neuroexcitatory β -N-oxalyl-L- α , β diaminopropionic acid (β -ODAP) (Vaz Patto and Rubiales, 2014) [15]. Though β -ODAP was reported by Rao *et al.*, (1964) [16] much after the characterization of L-hArg from lathyrus seeds by Rao *et al.*, (1963) [17] L-hArg went unnoticed as it was innocuous to experimental animals (Rao *et al.*, 1963) until 2008 when Valtonen *et al.*, established L-hArg as a common metabolite in humans. Though L-Arg is proved to be the substrate of NO, its methylated form L-hArg is also documented now as a potent substrate of NO. Since Lathyrus is the only known natural source of L-hArg, lathyrus

can be considered as a valuable source of the same.

Nitric oxide gained its momentum in the field of health and well-being as a significant bio molecule of cardiovascular system and cerebral metabolism (Napoli and Ignarro, 2009) [18] only during the previous decade after its discoverers Robert F. Furchgott, Louis J. Ignarro, and Ferid Murad were crowned with the Nobel Prize in 1998 and now the beneficiary effects of NO in health are acknowledged across the world and as well by the scientific community (Zhou and Zhu, 2009) [19]. Apart from L-Arginine the documented source of NOS, L-Homoarginine too is gaining momentum as substrate for NO. When compared the efficacy of L-Arg and L-hArg for the NO production endogenously, L-hArg convinced to be better in few aspects than L-Arg: a) Jyothi *et al.*, (1999) [20] reported that L-Homoarginine is almost 0.5% less active in comparison to that of L-Arg and also makes it a meagre substrate for hepatic arginase in mouse, rat and also the human. b) It's a weak arginase activity inhibitor c) it's a substrate for mouse brain NOS with the activity as half as that of L-Arg (Jyothi *et al.*, 1999) [20] d) It appears in the blood as early as 24 hours from the consumption of the lathyrus seeds (Nunn *et al.*, 1994) [21]. This makes lathyrus an appreciated dietary source of homoarginine occurring naturally.

The seeds of *L. sativus* contain 31% protein, 41% carbohydrate, 17% total dietary fiber (2% soluble and 15% insoluble), 2% fat and 2% ash, on a dry matter basis (Aletor *et al.*, 1994) [22].



Fig 1: Images of a) lathyrus plant flower b) lathyrus plant and c) lathyrus growing in drought areas source (Seidu, 2019) [23]

In order to ameliorate the neuro degenerative conditions attribute to the presence of β Oxalyldiaminopropionic acid (β -ODAP), the content of the same need to be reduced and for this there are various processing methods (Tekle-Haimont *et al.*, 1993) [24] though none of them could totally guarantee the destruction of β -ODAP completely they have been successful in destroying the β -ODAP upto 90%.

Conclusion

Despite the varied advantages in terms of agro climatic adaptation, it being the sole natural source of L-Homoarginine which has got a pivotal role to play in almost all the system functional if the body and it being used as non-conventional feed resource for animals, the Lathyrus is still not totally utilized due to the presence of β -ODAP a non-protein amino

acid which is a neurotoxin. Hence there is an ample amount of scope to study the Lathyrus supplementation to animals, various strategies that can ameliorate the levels of β -ODAP. Further, the L-Homoarginine is also not fully understood in terms of its role in patho physiology in humans and animals. Hence the studies on L-Homoarginine are also needed.

Conflict of Interest: No Conflict of Interest.

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